

HEL-TM-2-59
AD0213612

U. S. ARMY

REFERENCE SET

DO NOT REMOVE

Technical Memorandum 2-59

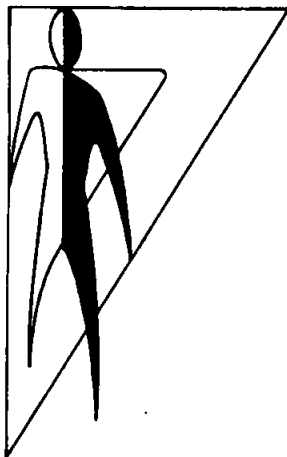
PROPERTY OF U.S. ARMY

A GUIDE TO
COLOR BANDING FOR INDICATORS (METERS)

William Wokoun
Gerald Chaikin

March 1959

HUMAN ENGINEERING LABORATORIES



ABERDEEN PROVING GROUND,
MARYLAND

TECHNICAL LIBRARY
ARMY RESEARCH LABORATORY
ABERDEEN PROVING GROUND

U. S. Army Human Engineering Laboratory
Library - Bldg 459
Aberdeen Proving Ground, MD 21005

459

NOTICES

This information is furnished for information purposes only with the understanding that it will not be released to any other nation without specific approval of the United States of America Department of the Army and that it will not be used for other than military purposes. It is understood that the furnishing of the attached plans, specifications, technical data, and other information to the recipient does not in any way constitute a license to make, use, or sell the subject matter of any inventions which may be embodied or described in the information so furnished, and any manufacture, use or sale which the recipient makes of any such inventions disclosed therein is at the risk of the recipient.

- - - -

Requests for additional copies of this report will be made to:

Armed Services Technical Information Agency
Arlington Hall Station
Arlington 12, Virginia

Attn: TICSCP-2

- - - -

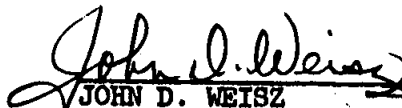
This report has been released to the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., for release to the general public.

A GUIDE TO
COLOR BANDING FOR INDICATORS (METERS)

William Wokoun
Gerald Chaikin

March 1959

APPROVED:


JOHN D. WEISZ
Director
Human Engineering Laboratory

U. S. ARMY HUMAN ENGINEERING LABORATORIES
Aberdeen Proving Ground, Maryland

ABSTRACT

This report presents a rationale for color-coded banding of meters. The principles set forth are illustrated, and swatches of the four colors which are considered maximally discriminable are given.

A GUIDE TO COLOR BANDING FOR INDICATORS (METERS)

Color-coded markings and bands should be utilized to optimize meter-reading performance in several ways: to make it obvious at a glance whether the indication falls within acceptable limits or at the desired value; to make it equally obvious when the indication falls within a "danger" range requiring immediate corrective action; and to preclude the possibility of mis-reading numbers on the meter scale or of mistaking the numerical value which is desired.

Each color of marking should have a clear-cut denotation. The standard meter-banding colors and their usual meanings follow:

a. Red indicates a dangerous condition requiring immediate corrective action. Red is not the converse of green; a range should not be banded red simply because it deviates from the desired operating point or range. But red bands should legitimately be used to indicate conditions under which equipment damage or personnel injuries are apt to result.

b. Green indicates the normal operating point or range; it shows the desired reading or the acceptable range of readings.

c. Blue is used in conjunction with green to indicate a secondary desired reading or range of readings. When there is overlap between the primary and secondary banded ranges, a separate scale should be used for each banded range, with the primary scale positioned closer to the index arc than the secondary scale. When there is no overlap between the primary and secondary banded ranges, the banding may then be incorporated on a single scale, provided there are no associated danger ranges. The more frequently used range should be shown in green; the less frequently used, in blue. If a selector switch or similar component is used to control the display, the dots, index marks, or switch bands showing positions of the selector should be colored blue when the associated indication is to be read in the blue range. Uncolored index marks, dots, or switch bands showing selector positions indicate that the reading should fall within the green range of the display.

d. Brown may be used to indicate a tertiary overlapping range if absolutely necessary. However, use of three or more overlapping operating ranges should be avoided except in very unusual cases where no other expedient can be utilized; banding will become a hindrance rather than a help if users must discriminate a bewildering spectrum of colors. In this instance a brown index mark should be used in conjunction with a selector switch or similar component as appropriate.

e. Amber should not be used as a meter banding color, for it indicates neither normal operation nor danger; hence its meaning can be conveyed adequately by leaving such ranges unmarked (white).

Just how many of these colors should be used to mark a meter depends on what the meter indications mean. It should be emphasized that it is not necessary to use all colors on each and every meter. For example, some meters may have danger ranges (red) but no particular range of normal readings; others may have normal operating ranges (green), yet none of the values outside the normal ranges necessarily indicate danger. Some meters may indicate pure operating conditions -- neither normal nor dangerous in themselves -- and require no color marking at all.

No attempt has been made thus far to give physical specifications for the colors used to band meters. Yet reds range from light pink to maroon, and greens run the gamut between faint chartreuse and very dark green. Obviously, the particular colors to be used should be selected with great care so they will be optimally discriminable from each other. It is particularly important that the red and green look as different as possible, since these colors will be used much more than blue and brown. If possible, the colors should differ not only in hue but in brightness and saturation to maximize their discriminability.

The color swatch sheet attached to this report as an Appendix shows samples of red, green, blue, and brown which the Human Engineering Laboratories evaluate as optimal. Both the red and the green are relatively light, the brown is of intermediate darkness, and the blue is dark. All four of these colors have been checked by a small sample of enlisted males under various kinds of light (outdoor, indoor fluorescent and incandescent, and reddish-orange night lighting). Although no completely color-blind subjects were tested, three color-weak individuals had no difficulty distinguishing the colors. Each of the colors shown on the swatch sheet is identified by approximate A. S. A. specifications and Munsell values, for greatest ease of matching. An exact match may be obtained from the identically-colored transparent Zipatone sheets, which were used as color displays for the tests described earlier in this paragraph.

It must be emphasized that the colors used in printing the dial-face illustrations may vary slightly from the standards shown on the color swatch sheet, since the former was prepared with the most-nearly-matching commercial ink color. In cases of discrepancy, the color swatch sheet should be regarded as the more accurate.

The part of the meter which is to be marked may be as small as a graduation of the meter scale or so large that it includes a third or more of the meter's range.

If the normal or desired reading is a point, the scale marking at that point should be appropriately colored (usually green; it would be most unusual for a single point to denote danger while readings on either side of the point were non-dangerous). This colored mark should be as long as it would ordinarily be; but it should be extended away from the indicator-needle pivot to an additional length which is half the length of the longest scale tick-mark. Figures 1 and 2 show how this kind of marking should look.

If the range to be banded is larger than a point, the range is delimited by an appropriately colored band. Two cases may be distinguished:

a. Numbers inside the index arc: Most pneumatic and hydraulic meters are numbered on the side of the index arc which is closer to the indicator-needle pivot; this is the case shown in Figures 1, 3, 5, and 7. With such meters, the colored band should be placed outside the index arc. Its width should be equal to the length of the longest subdivision in the scale.

b. Numbers outside the index arc: Some electrical meters are numbered on the side of the index arc which is farther from the indicator-needle pivot; since this case is considered undesirable from the human engineering standpoint, although perhaps necessary where the other type of meter is not available, no illustrations are shown. But with such meters, the colored band should be placed inside the index arc, overlapping the scale graduations. The light green and red to be used should not obscure the graduations themselves if numerical readings must be taken; however, blue or brown should be used with caution, since their darkness may make it difficult to see graduations. If feasible, this difficulty may be overcome by making the band just half as wide as it would otherwise be; but it may become difficult to discriminate very narrow bands of color.

The accompanying illustrations should make the application of these principles clearer. The four meter faces shown on the left side of the page are standard scaled meters which have been banded; the four shown on the right side are special so-called "go-no go"-type meters in which the numbers and graduations have been removed to preclude the possibility of their confusing personnel, but where circuitry does not lend itself to use of simple pilot-light indications. The eight meter faces shown form four horizontal pairs, indicating the way in which identical operating conditions would be indicated by banding a standard meter (left) or in making a special "go-no go"-type meter (right). Meter titles and selector switch position markings have been omitted.

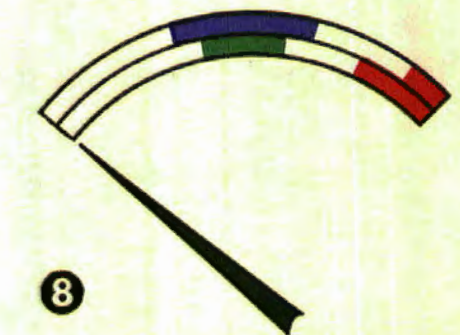
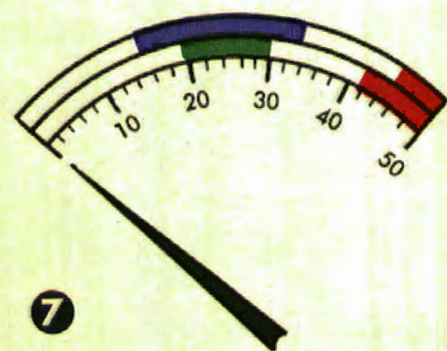
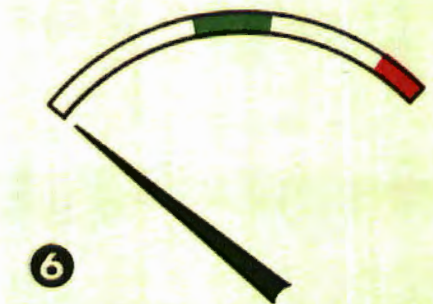
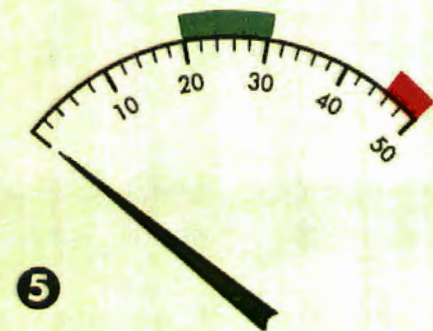
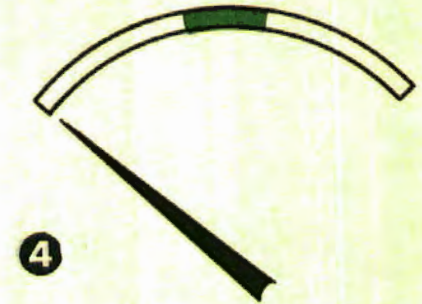
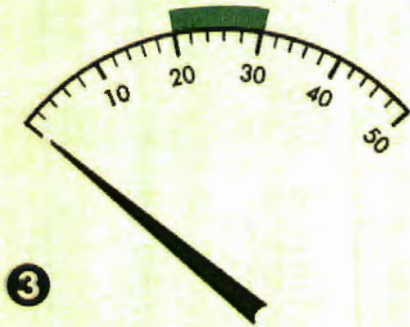
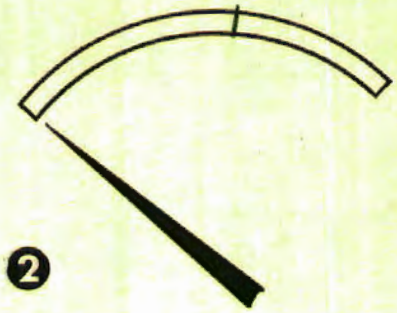
Figures 1 and 2 show how a desired reading (point, rather than range) would be indicated. This particular mark is green, as will virtually always be the case with point markings.

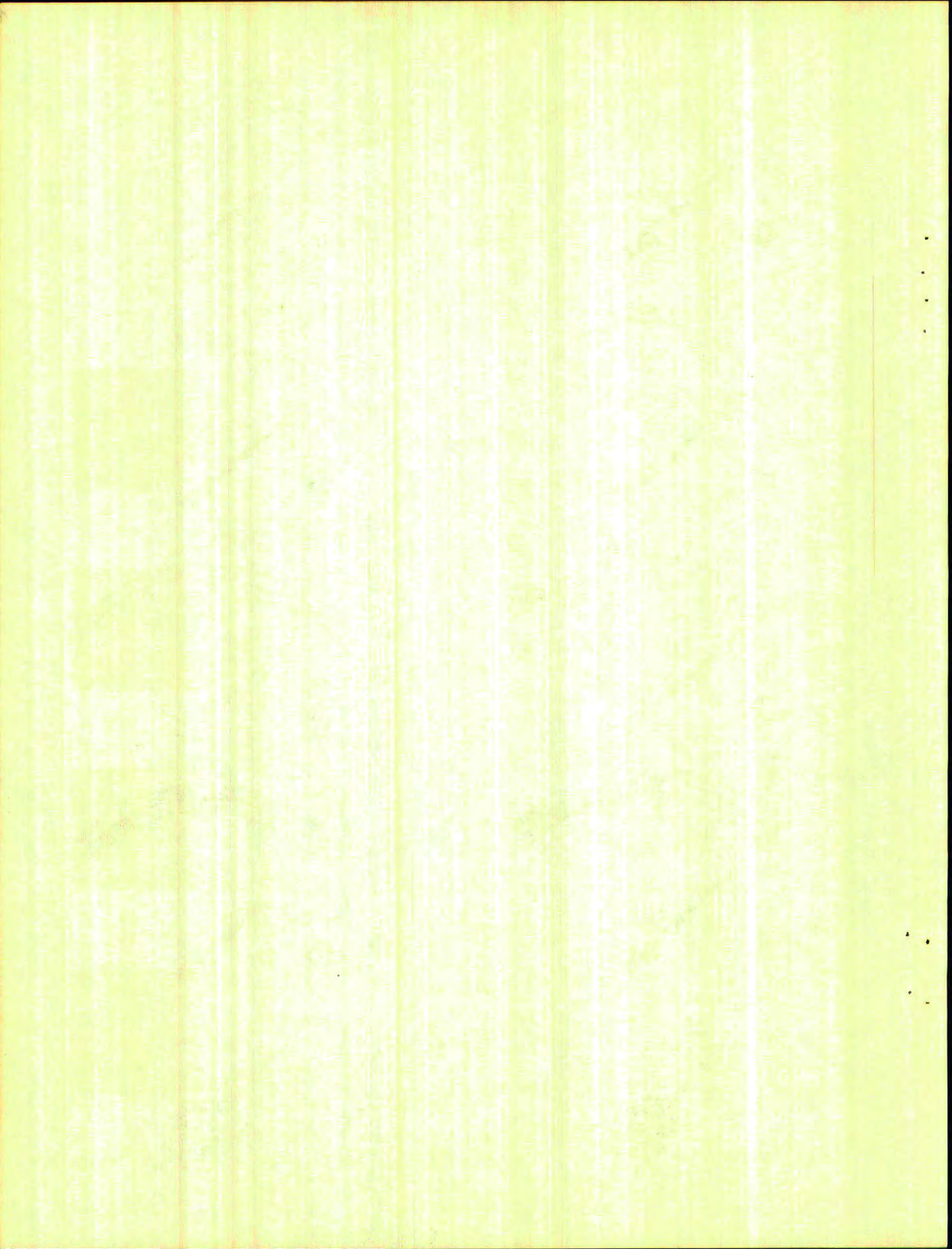
Figures 3 and 4 show how a normal or desired operating range would be banded. A similar band (red) could be used to show a danger range in this manner.

Figures 5 and 6 show meters in which there is both a normal operating range and a danger range.

Figures 7 and 8 illustrate the case where there are two overlapping normal operating ranges, each of which has its own associated danger range. Note that an arc is used above the blue band on the standard meter in this case, as well as between the green and blue bands. The additional arcs serve to prevent confusion between the two color-banded scales, as well as to integrate the color-banded scales with the meter scale itself. It should also be noted that the selector position which has its normal reading in the blue band has been indicated with a blue dot.

It should not be construed that the meters pictured herein are the best type of meter to use. It is realized that there are numerous types of meters which may be used for specific applications. These meters have been illustrated only as an example of how the preceding banding recommendations may be applied.





APPENDIX

COLOR SWATCHES FOR METER-BANDING

The following colors have been evaluated by the Human Engineering Laboratories for meter-banding suitability and are recommended as an optimally discriminable set of four colors for banding meters. These colors are appropriate for outdoor daylight use, indoor use under incandescent or fluorescent illumination, or use with a special reddish-orange night illumination (details of which are available on request).

RED

Zipatone "Medium Red"*

A. S. A. Specification--Monochromatic--616-14-59

Approximate Munsell value: 5R 4.5/14



GREEN

Zipatone "Light Green"*

A. S. A. Specification--Monochromatic--511-29-26

Approximate Munsell value: 5G 6.1/11



BLUE

Zipatone "Dark Blue"*

A. S. A. Specification--Monochromatic--462-7-61

Approximate Munsell value: 8PB 3.1/12



BROWN

Zipatone "Dark Brown"*

A. S. A. Specification--Monochromatic--592-12-37

Approximate Munsell value: 1YR 4.1/4



* Available from Para-Tone, Inc., 510-512 West Burlington Ave., La Grange, Ill.

AD _____ Accession No. _____
USA Ord Human Engineering Laboratory, Aberdeen
Proving Ground, Maryland.
A GUIDE TO COLOR BANDING FOR INDICATORS (METERS),
William Wokoun - Gerald Chaikin
Human Engineering Laboratory Report TM #2-59
7 pp, figures, Ord Proj No TUL-2031

Unclassified Report

This report presents a rationale for color-coded banding of meters. The principles set forth are illustrated, and swatches of the four colors which are considered maximally discriminable are given.

1. Color Banding Guide - Indicators (Meters)
2. Guide - Color Banding
3. Indicators - Color Banding
4. DA Proj. No. 8040
5140-14-01331

AD _____ Accession No. _____
USA Ord Human Engineering Laboratory, Aberdeen
Proving Ground, Maryland.
A GUIDE TO COLOR BANDING FOR INDICATORS (METERS),
William Wokoun - Gerald Chaikin
Human Engineering Laboratory Report TM #2-59
7 pp, figures, Ord Proj No TUL-2031

Unclassified Report

This report presents a rationale for color-coded banding of meters. The principles set forth are illustrated, and swatches of the four colors which are considered maximally discriminable are given.

1. Color Banding Guide- Indicators (Meters)
2. Guide - Color Banding
3. Indicators - Color Banding
4. DA Proj. No. 8040
5140-14-01331

AD _____ Accession No. _____
USA Ord Human Engineering Laboratory, Aberdeen
Proving Ground, Maryland.
A GUIDE TO COLOR BANDING FOR INDICATORS (METERS),
William Wokoun - Gerald Chaikin
Human Engineering Laboratory Report TM #2-59
7 pp, figures, Ord Proj No. TUL-2031

Unclassified Report

This report presents a rationale for color-coded banding of meters. The principles set forth are illustrated, and swatches of the four colors which are considered maximally discriminable are given.

1. Color Banding Guide - Indicators (Meters)
2. Guide - Color Banding
3. Indicators - Color Banding
4. DA Proj. No. 8040
5140-14-01331

AD _____ Accession No. _____
USA Ord Human Engineering Laboratory, Aberdeen
Proving Ground, Maryland.
A GUIDE TO COLOR BANDING FOR INDICATORS (METERS),
William Wokoun - Gerald Chaikin
Human Engineering Laboratory Report TM #2-59
7 pp, Figures, Ord Proj No TUL-2031

Unclassified Report

This report presents a rationale for color-coded banding of meters. The principles set forth are illustrated, and swatches of the four colors which are considered maximally discriminable are given.

1. Color Banding Guide - Indicators (Meters)
2. Guide - Color Banding
3. Indicators - Color Banding
4. DA Proj. No. 8040
5140-14-01331